Table 18. Ecological Management Zones in which programmatic actions are proposed that will assist in the recovery of species and species groups (continued).

Species and Species Group Visions	Ecological Management Zone[1]													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Saltmarsh Common Yellowthroat		●												
Bristly Sedge		●												
Point Reyes Bird's-Beak		●												
Crampton's Tuctoria	●									●				
Delta Mudwort		●								●	●			
Delta Tule Pea	●	●												
Alkali Milk-Vetch		●	●			●				●	●	●	●	●
Delta Coyote-Thistle											●	●	●	●
Species with the Designation "Maintain"														
Mad-dog Skullcap											●			
Rose-Mallow			●			●	●	●	●	●	●	●		●
Eel-grass Pondweed	●					●		●	●	●	●		●	
Colusa Grass		●	●			●				●	●	●	●	●
Boggs Lake Hedge Hyssop		●	●	●	●	●	●	●	●	●	●			
Green's Legenere			●	●						●				
Contra Costa Goldfields		●								●				
Recurved Larkspur and Heartscale	●	●				●	●	●		●		●	●	●
California Freshwater Shrimp		●												
Hardhead	●		●	●	●	●	●	●	●	●	●	●	●	●
Western Least Bittern	●	●	●	●								●		

Table 18. Ecological Management Zones in which programmatic actions are proposed that will assist in the recovery of species and species groups (continued).

Species and Species Group Visions	Ecological Management Zone[1]													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
California Red-Legged Frog	●	●				●	●		●		●	●	●	●
Western Pond Turtle	●	●				●	●		●		●	●	●	
California Tiger Salamander	●													
Western Spadefoot	●			—										
Species with the Designation "Enhance and/or Conserve Biotic Communities"														
Lamprey	●	●	●	●	●		●	●	●	●	●	●	●	
Native Resident Fish Species	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Native Anuran Amphibians	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Waterfowl	●	●	●	●	●	●	●	●	●		●	●	●	●
Shorebird and Wading Bird Guild	●	●											●	
Neotropical Migratory Bird Guild	●	●	●	●						●	●	●	●	●
Bay-Delta Foodweb Organisms	●	●												
Plant Communities														
Species with the Designation "Maintain and/or Enhance Harvested Species"														
White Sturgeon	●	●	●					●				●		
Striped Bass	●	●	●					●	●			●		
American Shad	●	●	●					●	●			●		
Non-native Warmwater Gamefish	●	●	●							●	●	●	●	●

Table 18. Ecological Management Zones in which programmatic actions are proposed that will assist in the recovery of species and species groups (continued).

Species and Species Group Visions	Ecological Management Zone[1]													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Pacific Herring		●												
Grass Shrimp		●												
Signal Crayfish	●		●											
Upland Game	●		●	●						●	●	●	●	●

[1] 1 = Sacramento-San Joaquin Delta
2 = Suisun Marsh/North San Francisco Bay
3 = Sacramento River
4 = North Sacramento Valley
5 = Cottonwood Creek
6 = Colusa Basin
7 = Butte Basin
8 = Feather River/Sutter Basin
9 = American River Basin
10 = Yolo Basin
11 = Eastside Delta Tributaries
12 = San Joaquin River
13 = East San Joaquin Basin
14 = West San Joaquin Basin

◆ SPECIES DESIGNATED FOR RECOVERY

INTRODUCTION

The Strategic Plan for Ecosystem Restoration presents 6 goals to guide the implementation of restoration actions during the 20-30 year program.

The first Strategic Goal focuses on at-risk species which includes all species designated for recovery by the MSCS and the ERP.

> *STRATEGIC GOAL 1: Achieve, first, recovery and then large self-sustaining populations of at-risk native species dependent on the Delta and Suisun Bay; support similar recovery of at-risk native species in San Francisco Bay and the watershed above the estuary; and minimize the need for future endangered species listings by reversing downward population trends of native species that are not listed.*

RECOVERY DESIGNATION

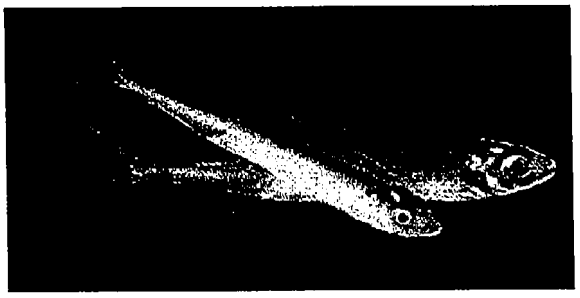
RECOVERY "R": For species designated "R," CALFED has established a goal to recover the species within the CALFED ERP Ecological Management Zones. A goal of "recovery" was assigned to those species whose recovery is dependent on restoration of the Delta and Suisun Bay/Marsh ecosystems and for which CALFED could reasonably be expected to undertake all or most of the actions necessary to recover the species. Recovery is achieved when the decline of a species is arrested or reversed, threats to the species are neutralized, and thus, the species' long-term survival in nature is assured.

Recovery is equivalent, at a minimum, to the requirements for delisting a species under FESA and CESA. Certain species, such as anadromous fish, have threats outside the geographic scope or purview of the CALFED Program (i.e., ocean harvest regulated by the Magnuson-Stevens Act). Therefore, in some instances CALFED may not be able to complete all actions potentially necessary to recover the species; however; however, CALFED will implement all necessary recovery actions within the ERP Ecological Management Zones. For other species, CALFED aims to achieve more than would be required for delisting (e.g., restoration of a species and/or its habitat to a level beyond delisting requirements). The effort required to achieve the goal of "recovery" may be highly variable between species. In sum, to achieve a goal of "recovery" implies that CALFED is expected to undertake all actions within the ERP Ecological Management Zones and Program scope necessary to recover the species.

The "recover" species addressed in this section include:

- Delta smelt
- Longfin smelt
- Green sturgeon
- Splittail
- Sacramento winter-run chinook salmon
- Central Valley spring-run chinook salmon
- Late-fall-run chinook salmon
- Fall-run chinook salmon
- Central Valley steelhead
- Mason's lilaeopsis
- Suisun Marsh aster
- Suisun thistle
- Soft bird's-beak
- Antioch Dunes evening-primrose
- Contra Costa wallflower
- Lange's metalmark butterfly
- Valley elderberry longhorn beetle
- Suisun ornate shrew
- Suisun song sparrow, and
- San Pablo song sparrow.

Note: the use of Species Targets in this section is synonymous with the Species Goal Prescriptions provided in the Multi-species Conservation Strategy.



INTRODUCTION

The delta smelt is a native estuarine resident fish. Delta smelt are found mainly in the waters of the Sacramento-San Joaquin Delta and in Suisun and San Pablo bays. They are found only in the Sacramento-San Joaquin Estuary. Delta smelt are most abundant in Montezuma Slough, Suisun Bay, and the western Delta, but beginning in December and continuing through perhaps June 30, migrate upstream and are more abundant in the Delta. They have been found as for upstream as the mouth of the American River on the Sacramento River at Mossdale on the San Joaquin River. Human-caused adverse habitat modifications reduced delta smelt populations resulting in its listing as threatened under State and federal Endangered Species Acts

Major factors that limit this species' contribution to the health of the Delta are adverse effects of low Delta outflow, poor foodweb productivity, reduced low-salinity habitat, losses to water diversions, poor spawning habitat, and potentially higher concentrations of toxins.

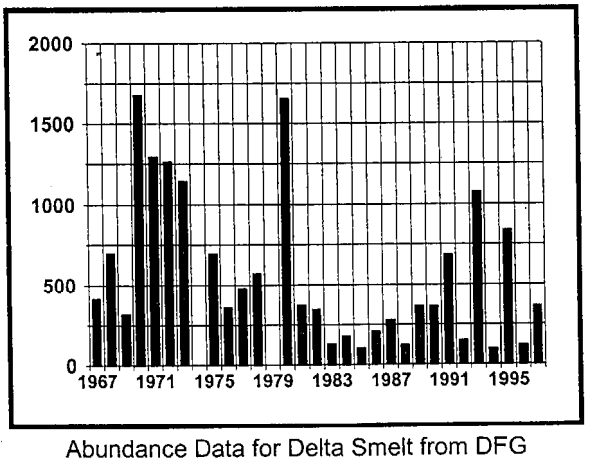
RESOURCE DESCRIPTION

Delta smelt are native to the Sacramento-San Joaquin Delta estuary and represent an important component of the historic native fish fauna and Bay-Delta foodweb (i.e., as a prey species for species such as chinook salmon). Delta smelt's 1-year life span and relatively low reproductive rate make its population abundance sensitive to short-term habitat changes. As a consequence, the population abundance of delta smelt is characterized by sharp declines followed by dramatic recovery. Low abundance through the drought years (1987-1992) indicated need for actions to restore the delta smelt population. Delta smelt are considered environmentally sensitive because the have a one year life cycle, unusually low fecundity, a limited diet, and reside primarily within the interface between salt and freshwater.

During late-winter to early-summer, delta smelt migrate to freshwater to spawn. Females only produce between 1,000 and 2,600 eggs which sink to the bottom and attach to the substrate. Spawning habitat includes shallow freshwater sloughs and edge waters with firm substrate, submerged vegetation, and woody debris. Rearing habitat includes shallow freshwater and low salinity (less than 6-8 ppt salinity) habitats that provides a protective, food-rich environment. Such habitats include shallow bays, tidal sloughs, shoals, shorelines, and marsh channels.

Land reclamations in the Bay-Delta have diminished the quality and quantity of shallow-water, marsh-slough habitat. Remaining shallow-water, low-salinity habitat is further reduced in dry-water years because of extensive water diversions from the Delta.

Population abundance during 1993 and 1995 (relative to abundance during the 1987-1992 drought) suggests that recovery potential may be high. Sharp population declines during drought conditions (as in 1994), however, illustrate the potential threat of poor conditions to the species' survival under existing habitat and stressor conditions. A preliminary low abundance index in 1996, a wet year, is further cause for concern. The fall



Abundance Data for Delta Smelt from DFG September through December Fall Mid Water Trawl Survey.

mid water trawl (FMWT) is best measure of delta smelt abundance (Sweetnam and Stevens 1993) as it measures the abundance of pre-spawning adults. It includes cumulative data for 35 sampling stations.

Delta smelt tolerate a wide range of salinity but are most abundant in the Bay-Delta estuary, where salinity is around 2 parts per thousand (ppt). Spawning occurs in freshwater in the upstream areas of the Delta. Construction of levees in the 1800s created narrow channels and eliminated vast areas of marshes and interconnecting sloughs. Marshes and adjoining sloughs are very productive and support an abundance of zooplankton, on which delta smelt feed, and are important as spawning and rearing habitat for the species.

Reduced freshwater outflow during the late winter and spring of dry years allows saltwater to move farther upstream in the estuary than during wet years. This reduces the amount of low-salinity habitat for delta smelt. The increased upstream saltwater movement changes the location of habitat that meets the salinity needs of the delta smelt, similar to effects on other Delta fish species such as striped bass, longfin smelt, and Sacramento splittail. Habitat location is shifted upstream from the relatively shallow, productive bays, marshes, and sloughs of Suisun Bay and into the narrow, deeper, and less-productive channels of the Delta.

The upstream shift also increases exposure to Delta water diversions. Water is drawn from the Delta by hundreds of small agricultural diversions, Central Valley Project (CVP) and State Water Project (SWP) South Delta export pumps, and Pacific Gas & Electric (PG&E) power generation facilities. During most years, large numbers of delta smelt are lost to Delta diversions.

Food availability, toxic substances, competition and predation (particularly from non-native species), and loss of genetic integrity through hybridization with the introduced Japanese pond smelt (wagasaki) also are other factors believed to influence smelt abundance.

Overall, the threats to the population, in decreasing order of importance, are:

- reduction in outflow from the Estuary,
- entrainment to water diversions,
- extremely high outflow,
- changes in food organisms,
- toxic substances,
- disease, competition, and predation, and
- loss of genetic integrity by hybridization with introduced wagasaki.

VISION

The vision for delta smelt is to recover this State- and federally listed threatened species in order to contribute to the overall species richness and diversity of the Bay-Delta and to improve water management for beneficial uses of the Bay-Delta system.

Achieving this vision will reduce the conflict between protection for this species and other beneficial water uses in the Bay-Delta. Increases in the population and distribution of delta smelt can be realized through habitat restoration accompanied by reductions in stressors.

Delta smelt would benefit from the many expected improvements in ecosystem processes and habitats, and reductions in stressors. These improvements will result from the wide variety of actions proposed for the Delta and Suisun Bay. Improvements in streamflow (Delta inflow and outflow) would better attract adults to spawning habitat, ensure transport or movement of larvae and early juveniles to productive rearing habitat, and maintain productivity and suitability of spawning and rearing habitat, including production of food. Additional freshwater flow could be provided by reservoir releases during spring to maintain salinity requirements of delta smelt in areas that provide high quality nursery habitat, such as Suisun Bay and Marsh.

Delta smelt would benefit from spawning and rearing habitat restoration. Habitat restoration may be achieved by adding and modifying physical habitat and creating additional freshwater flow during critical periods. More habitat can be created by breaching levees to inundate lands once part of the Bay and Delta, setting levees back to increase shallow-water habitat along existing channels, protecting existing shallow-water habitat from erosion, and filling relatively deep water areas with sediments to create shallow-water habitat.

Reducing stressors is a major component of delta smelt restoration. Reducing delta smelt losses to diversions is of primary concern.

Recovery Goals

The basic strategy for the recovery of delta smelt is to manage the estuary is such a way that it is a better habitat for native fish in general and delta smelt in particular (U.S. Fish and Wildlife Service 1996). Improved habitat will allow delta smelt to be widely distributed throughout the Delta and Suisun Bay. Recovery of delta smelt will occur in two phases, restoration and delisting. Restoration is defined as a return of the population to pre-decline levels, but delisting is not recommended until the population has been tested by extreme outflows. Delta smelt will be considered restored when its population dynamics and distribution pattern within the estuary are similar to those that existed in the 1967-1981 period.

If abundance and distributional criteria are met for a five-year period, the species will be considered restored. Delta smelt will meet the remaining recovery criteria and be considered for delisting when abundance and distribution criteria are met for a five-year period that includes two successive extreme outflow years, with one year dry or critical.

Integration with Other Restoration Programs

Efforts to restore delta smelt involve cooperation and support of other established programs that are protecting and improving conditions for delta smelt and other species in the Bay and Delta.

- The Recovery Plan for the Sacramento/San Joaquin Delta Native Fishes (U.S. Fish and Wildlife Service 1996) would be considered in developing actions.
- The Central Valley Project Improvement Act will implement actions that will benefit delta smelt, including changing the timing of diversions, restoring habitat, and dedicating flow during critical periods (U.S. Fish and Wildlife Service 1997).
- Federal ESA requirements (biological opinions and habitat conservation plans) will ensure maintenance of existing habitat conditions and implementation of recovery actions.
- The State Water Resources Control Board will implement the Water Quality Control Plan for the San Francisco/Sacramento-San Joaquin Delta estuary, which includes provisions to limit entrainment in diversions and protect habitat conditions for delta smelt, chinook salmon, striped bass, and other species.

Linkage with Other Ecosystem Elements

Successful restoration of delta smelt will be closely tied with improving late winter and spring Delta outflow, increasing shallow water and wetland-slough habitat, improving the productivity of the aquatic foodweb, reducing the effects of Delta water diversions, and reducing the level of contaminants in Bay-Delta waters. Restoration actions are similar to those prescribed for other native resident and anadromous fish including longfin smelt and striped bass.

Maintenance of rearing habitat is extremely important for the recovery of delta smelt and other native Delta species. Successful restoration of delta smelt will also be closely tied with improving Delta outflow that maintains the X2 location in Suisun Bay for rearing delta smelt and prevent adverse influence of the CVP/SWP export facilities in the southern Delta.

Objective, Targets Actions, and Measures

The Strategic Objective is achieve, first, recovery and then large self-sustaining populations of at-risk species dependent on the Delta, Suisun Bay, and Suisun Marsh.

Species Target: The fall mid-water trawl survey in September and October must capture delta smelt in all zones in 2 out of 5 consecutive years and in at least 2 zones in 3 out of the 5 consecutive years, and in at least 1 zone in all 5 years; and the 5

consecutive years must include 2 sequential extreme outflow years (i.e., at least one critical or dry year followed by a critical, dry, or wet year) and the fall mid-water trawl catch for September and October must exceed 239 for 2 out of 5 years and not fall below 84 for more than 2 consecutive years.

LONG-TERM OBJECTIVE: To restore delta smelt abundance to levels that existed in the 1960s and 1970s, as measured over a period of at least 10 years.

SHORT-TERM OBJECTIVE: Achieve the recovery goals for delta smelt identified in the Delta Native Fishes Recovery Plan.

RATIONALE: The annual life cycle of delta smelt contributes to wide interannual variation in abundance, necessitating multiple sample years to discern a trend in abundance. Delta smelt were extremely abundant in the system when the "standard" trawling program in the Delta began in the 1960s. This period is used as a standard simply because that is when the data available for comparative purposes begin. Conditions in the estuary were clearly favorable for the species in that period. Achieving the long-term objective may be impeded by the presence of several introduced species, notably the clam, *Potamocorbula amurensis*, inland silversides, and wakasagi. If future investigations determine that substantial reductions in Delta smelt are attributable to the introduced species already established, the long-term population abundance objective may need to be lowered.

STAGE 1 EXPECTATIONS: In 7-10 years, the delta smelt population indices should be within the same range as during 1990-1998. The basic factors limiting delta smelt distribution and abundance should be determined (e.g., reduced food supply, interactions with non-native species, negative effects of diversions) and, where feasible, overcome through habitat and ecosystem process restoration.

RESTORATION ACTIONS

The targets for delta smelt include exceeding a fall midwater trawl catch index of 240 in dry water-year types and a wider distribution of delta smelt in the trawl survey.

The following general restoration actions would contribute to improving the delta smelt population:

- Improve Delta outflow during the late winter and spring to improve foodweb productivity and to disperse larvae and juveniles to downstream rearing habitat in Suisun Bay.
- Maintain Delta outflow once larvae and juveniles have reached downstream rearing habitat to keep them beyond the "zone of influence" of the CVP/SWP and agricultural diversions.
- Increase the residence time of X2 at key locations in Suisun Bay (e.g., Roe Island, Chipps Island, and Collinsville).
- Reduce adverse effects of CVP and SWP diversions during the period when larvae, juveniles, or adult life stages appear in the Delta.
- Increase the amount of shallow-water habitat in areas critical to spawning and rearing.
- Construct and improve fish facilities for Delta diversions, including agricultural diversions and CVP and SWP diversions, and improve handling and salvage practices at diversions.
- Develop and implement a program to reduce the adverse effects of introduced aquatic species and the potential for future introductions.
- Implement restoration actions identified in the Recovery Plan for the Sacramento/San Joaquin Delta Native Fishes Recovery Plan.

MSCS CONSERVATION MEASURES

The following conservation measures were included in the Multi-Species Conservation Strategy (1999) to provide additional detail to ERP actions that would help achieve species habitat or population targets for delta smelt.

- Coordinate protection, enhancement, and restoration of occupied delta smelt habitats with other federal, state, and regional programs (e.g., the San Francisco Bay Area Wetlands Ecosystem Goals Project, the Anadromous Fish Restoration Program, and the U.S. Fish and Wildlife Service recovery plans) that could affect management of current and historic habitat use areas to avoid potential conflicts among management objectives and identify opportunities for achieving multiple management objectives.

- To the extent consistent with CALFED objectives, direct ERP actions towards setting back levees in the south Delta to increase shallow water habitat.
- Restore and enhance delta smelt habitat to provide suitable water quality (i.e., low concentrations of pollutants) and substrates for egg attachment (submerged tree roots, branches, rock, and emergent vegetation) to important spawning areas.
- Expand the Interagency Ecological Program (IEP) monitoring efforts in the south Delta for delta smelt.
- To the extent consistent with CALFED objectives, initiate implementation of the U.S. Fish and Wildlife Service's "Rainbow Report" or similar documentation to provide increased water quality in the south Delta and eliminate or reduce the need for installation of barriers.
- Monitor to determine if artificial substrates are used by delta smelt for spawning.
- Protect critical rearing habitat from high salinity (>2 ppt) and high concentrations of pollutants from the beginning of February to the end of August.
- Allow delta smelt unrestricted access to suitable spawning habitat and protect these areas from physical disturbance (e.g., heavy equipment operation) and flow disruption in the period from December to July by maintaining adequate flow and suitable water quality to attract migrating adults in the Sacramento and San Joaquin River channels and their tributaries, including Cache and Montezuma Sloughs and their tributaries.
- All in-channel modification projects implemented under CALFED should use best management practices to minimize mobilization of sediments that might contain toxins, localize sediment movement, and reduce turbidity.

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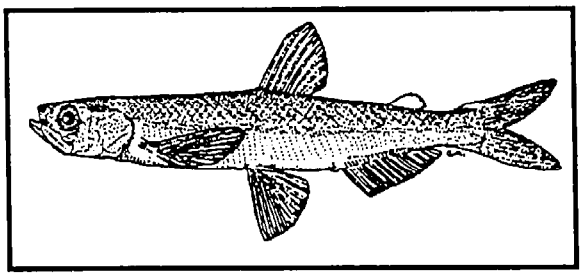
◆ LONGFIN SMELT



INTRODUCTION

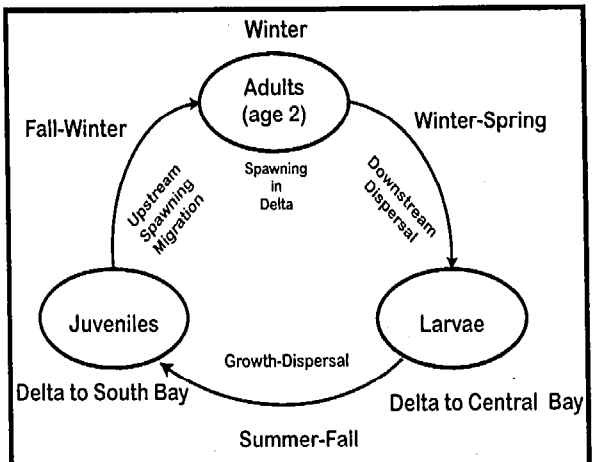
Longfin smelt are small native fish that live in the brackish waters of San Francisco Bay and the Delta. They can be found in water ranging from sea water to completely fresh water (Moyle 1976). They are an important element of the Bay-Delta foodweb as prey for chinook salmon, striped bass, and other predatory fish species. Because their abundance dropped sharply during dry periods over the past several decades, they are designated by the California Department of Fish and Game (DFG) and U.S. Fish and Wildlife Service (USFWS) as a species of special concern. Longfin smelt abundance was especially low during the 1987-1992 drought and showed signs of recovery only in 1995.

Major factors that limit this species' contribution to the health of the Delta are related to the adverse effects of low Delta outflow and include associated poor foodweb productivity, greater effects of water diversions, poorer larval transport and habitat conditions (i.e., poor dispersal is related to poor survival), and potentially higher concentrations of toxins that may limit its survival and production during droughts.

RESOURCE DESCRIPTION

The largest, southernmost populations of longfin smelt in California inhabits San Francisco Bay and the Delta. Elsewhere in California, the longfin smelt is known from the Eel River, Humboldt Bay, and the Klamath River estuary, but none have been collected at these locations since the early 1990s. Longfin smelt migrate upstream into the Delta to spawn. Longfin smelt are well-adapted to the Bay-Delta estuary and are also found in other west-coast estuaries from northern California to southern Alaska.

In the Bay-Delta estuary, longfin smelt is anadromous. Adults, fish approaching their second year of age, migrate in winter from saltwater portions of the Bay and open coast to spawn in freshwater portions of the upper Bay and Delta. Spawning occurs in habitats with hard-bottom or plant substrates such as tidal wetlands and channels. Most spawning takes place from late December through April. High winter and early spring flows transport and disperse buoyant, newly hatched larvae downstream into Suisun and San Pablo bays, where the plankton food supply is characteristically abundant and necessary for high survival of longfin smelt larvae and juveniles. Flows of the magnitude to accomplish this increase the area and shifts the location of intermediate salinity (1.1 - 18.5 ppt) habitat downstream reducing competition and predation from marine and freshwater fishes.



Longfin Smelt Life Cycle. California Department of Fish and Game, 1992.

Since longfin smelt spawn primarily as age 2 fish, they tend to maintain strong even-year or odd-year cohorts, depending upon the sequence of wet and dry years. After the extended drought ended in 1978, the longfin smelt even-year cohort was dominant in the 1980s, until the next drought broke in 1993 and allowed the odd-year cohort a recruitment advantage. Abundance is a function of both outflow and habitat conditions and adult population size which is related to fecundity. Peak abundance index levels are not reached until favorable flow conditions persist for 2-3 generations.